

The Role of Agriculture in Nigeria's Economic Growth
A General Equilibrium Analysis
(Paper in progress)

Marinos Tsigas and Simeon Ehui

Introduction

Nigeria faces serious poverty challenges. Two out of every three Nigerians live below the poverty line of \$1 per day in income. Poverty in Nigeria is concentrated in rural areas, which are home to more than 70 percent of the nation's poor. Development indicators for rural areas lag behind those for urban areas: incomes are lower, infant mortality rates are higher, life expectancy is shorter, illiteracy is more widespread, malnutrition is more prevalent, and greater proportions of people lack access to clean water and improved sanitation services.

For the foreseeable future, the welfare of rural populations in Nigeria will be tied to agriculture. Agriculture is the backbone of the rural economy, generating about 30 percent of gross domestic product (GDP) and providing by far the largest source of rural employment. Growth in Nigeria's agricultural sector, while better than the growth achieved in many other African countries, has fallen short of expectations. Value added per capita in agriculture has risen by less than 1 percent per year for the past 20 years, and food production gains have not kept pace with population growth, resulting in rising food imports and declining levels of national food self-sufficiency.

Blessed with abundant land and water resources, Nigeria's agricultural sector has a high potential for growth, but this potential is not being realized. Productivity is low and basically stagnant. Farming systems, which are mostly small in scale, are still predominantly subsistence-based and for the most part depend on the vagaries of the weather. The country's vast irrigation

potential remains largely unexploited. Most farmers produce mainly food crops using traditional extensive cultivation methods, while commercial agriculture based on modern technologies and purchased inputs remains underdeveloped. The capacity of the agricultural research system has eroded in recent years, as has that of the extension service, so, even when improved technologies are available, often they fail to reach farmers. Farmers' lack of technical knowledge is compounded by deficiencies in input distribution systems, which limit the timely availability of improved seed, fertilizer, crop chemicals, and machinery. Where inputs are available, farmers' ability to use them is often compromised by a lack of credit, because rural financial institutions are in general poorly developed. Farmers who produce surpluses frequently lack access to reliable markets, and the high cost of transporting produce to distant buying points over bad rural roads reduces their competitiveness.

Government has been unable to resolve these problems. Many agricultural policies have been ineffective, either because they have been misguided, or because their impacts have been swamped by macro policies affecting inflation, exchange rates, and the cost of capital. The rapid expansion of the oil sector has also played a role in eroding the competitiveness of agriculture, because successive governments have chosen the easy path of relying heavily on earnings from oil exports rather than making the investments needed to diversify the economy by maintaining productivity growth in agriculture and other non-oil sectors.

Recognizing these challenges, the Federal Government of Nigeria has identified the modernization of the agricultural sector as a major priority. President Obasanjo, one of the founding members of the New Economic Partnership for Africa (NEPAD), has repeatedly expressed a commitment to meeting the NEPAD goal of investing at least 10 percent of the national budget in agriculture and related activities. The National Economic Empowerment and

Development Strategy (NEEDS) also explicitly recognizes the strategic importance of the agricultural sector and lists a number of special initiatives that the Federal Government intends to pursue in promoting increased food and agricultural production. The NEEDS sets out a series of quantitative performance targets to be achieved by 2007, including 6 percent annual growth in agricultural GDP, US \$3 billion per year in agricultural exports, and 95 percent national food self-sufficiency.

While there is interest in modernizing agriculture, there is insufficient knowledge about the growth potential of the agricultural sector in Nigeria. Some still ask if it is appropriate to focus on agriculture and source of growth in Nigeria. In this paper we apply the GTAP framework, an applied general equilibrium model, to estimate the growth potential of agriculture in Nigeria.¹

The Approach

A global and economy-wide approach is most appropriate for our analysis. When certain agricultural industries in Nigeria gain in productivity, other agricultural sectors would be affected too not only through price changes in intermediate inputs (e.g., cheaper feed grains), but also through price changes in primary factors (e.g., labor), which would affect incomes, and consumption of food items. The global markets aspect of our approach is important too. The extent and conditions of international trade would determine the benefits accruing to the Nigerian economy.

¹ Recently the 1999 Nigeria Input-Output statistics were included in the GTAP database. The GTAP framework is fully documented in Chapters 2-5 in T.W. Hertel (ed.), *Global Trade Analysis: Modeling and Applications*, Cambridge, Cambridge University Press, 1997; and in B.V. Dimaranan and R.A. McDougall, *Global Trade, Assistance, and Production: The GTAP 6 Data Base*, Center for Global Trade Analysis, Purdue University, 2005.

The GTAP applied general equilibrium model is based on assumptions that are common in the literature: perfect competition, constant returns to scale, and no change in the economy-wide employment of resources. Each regional economy consists of several economic agents: on the final demand side of the model, a utility-maximizing household purchases commodities (for private and government use) and it saves part of its income, which consists of returns to primary factors and net tax collections. On the production side of the model, cost-minimizing producers employ primary factor services and intermediate inputs to supply commodities.

This analysis is based on data consisting of 19 regions and 31 sectors/commodities. Nigeria and 12 other economies cover Sub-Saharan Africa; other economies are North America, the European Union, Japan, Indonesia, Rest of Asia and the rest-of-the-world (ROW). Twelve sectors cover primary agriculture; nine sectors cover processed foods; the rest of natural resource industries, manufactures, and services are covered with 10 sectors.

We run a series of simulations to assess the impact of productivity improvements and policy changes on Nigeria's growth. In particular, we simulated:

- o sector-specific Hicks-neutral technical change (augmenting the returns to all productive factors equally);
- o factor-biased technological change (e.g., land-specific productivity improvements vs. capital-specific productivity improvements);
- o improvements in domestic and foreign trade transportation; and
- o trade liberalization by Nigeria.

Findings

Tables 1, 2 and 3 and figures 1 and 2 summarize our work thus far.

Table 1 and Figure 1 show the welfare effects from 1% sector-specific Hicks-neutral technological improvements in four economies: Nigeria, Uganda, Zimbabwe and Indonesia. Table 1 shows sector sales, welfare effects and the ratio of welfare effect to sales, by sector. In Nigeria, the oil sector accounts for over a quarter of the economy. Thus, 1% technological progress in the oil sector gives large welfare benefits in dollar terms, \$142.72 million. No other sector in Nigeria gives larger welfare gains.

Figure 1 focuses on medium to large sectors in the 4 economies, i.e., sectors with more than \$100 million in sales. To address the size-of-sector issue, we divided welfare gains by the value of the sector's output and that magnitude is shown on the vertical axis of figure 1. For Nigeria, several food and agricultural sectors have a value that is higher than that for the oil sector: cattle (1.23%), other livestock (1.23%), other grains (1.04%) and fruits and vegetables (1.02%). In Indonesia, Zimbabwe and Uganda, agricultural sectors rank low. The effects for Nigeria suggest that comparable investments would yield higher returns in some agricultural sectors than in oil.²

Figure 2 shows the welfare effects from 1% factor-biased technological progress in Nigeria.³ Technological improvements related to unskilled labor produce by far the highest returns in agriculture: cattle, other livestock and fruits and vegetables have the highest returns. In manufacture, the highest returns are obtained from technological improvements related to capital.

Table 2 shows output effects, by sector, from 1% improvement in international and domestic transportation. International transportation improvements lower the cost of both

² See Ehui and Tsigas for an attempt to prioritize investments in a general equilibrium framework.

³ Welfare effects in figure 2 are measured as a percentage of the sector's output.

Nigerian exports and imports: improvements in Nigeria's terminal facilities (e.g., ports and airports) as well as improvements in Nigeria's import and export procedures.

The economy-wide effect of 1% international transportation improvements is that Nigeria gains 0.06 percent in welfare, around \$21 million. Exports and imports contribute equally to the welfare gains. The economy-wide effect of 1% domestic transportation improvements is that Nigeria gains 0.17 percent in welfare, around \$63 million.

The agricultural sectors that benefit the most (in dollar terms) from transportation improvements are fruits and vegetables, cattle and other livestock. Other manufacturing is the sector that benefits the most from domestic transportation improvements.

Table 3 shows the output and trade effects from trade liberalization in Nigeria, i.e., removal of all Nigerian tariffs in the GTAP model. The economy-wide effect of this policy change is that Nigeria gains 0.90 percent in welfare, around \$342 million: the allocative efficiency gains are \$391 million; terms of trade deteriorate by \$51 million. The agricultural sectors that expand the most, in dollar terms, are other crops, cattle and other livestock. Exports of other crops increase by \$12 million while imports of fruits and vegetables increase by \$22 million. Nigeria's participation in a global free trade agreement would raise Nigeria welfare gains to 1.15 percent, around \$434 million.

Summary

There is interest in modernizing Nigerian agriculture but there is insufficient knowledge about the growth potential of agriculture. This paper employed applied general equilibrium model to estimate the growth potential of agriculture in Nigeria. We found that a few agricultural sectors may outperform several manufacturing sectors.

References

S. Ehui and M. Tsigas, 2005, "Identifying agricultural investment opportunities in sub-Saharan Africa: A global, economy-wide analysis," paper presented at 8th *Annual Conference on Global Economic Analysis*, June 9-11, Lübeck, Germany.

Table 1. Welfare gains from 1% sector-specific Hicks-neutral technological progress, by sector

Sector	Nigeria				Indonesia				Uganda				Zimbabwe			
	Output	EV	100 * EV/Output	Rank	Output	EV	100 * EV/Output	Rank	Output	EV	100 * EV/Output	Rank	Output	EV	100 * EV/Output	Rank
Paddy rice	335	3.41	1.02	17	5,120	48.47	0.95	12	32	0.40	1.23	13	1	0.02	1.01	13
Wheat	7	0.09	1.23	5	13	0.12	0.96	10	4	0.06	1.42	10	43	0.51	1.18	4
Other grains	919	9.60	1.04	14	824	7.09	0.86	24	322	3.20	0.99	27	189	1.93	1.02	10
Fruits, vegetables	5,181	52.78	1.02	16	5,210	47.69	0.92	19	1,655	16.65	1.01	26	143	1.12	0.78	28
Oilseeds	151	1.37	0.91	23	1,126	10.07	0.89	21	52	0.59	1.14	17	47	0.42	0.90	25
Sugar cane	7	0.08	1.10	13	843	7.94	0.94	15	86	1.04	1.20	14	117	0.99	0.85	26
Plant fibers	65	0.53	0.81	24	78	0.81	1.03	3	30	0.54	1.81	9	239	2.02	0.84	27
Other crops	201	1.56	0.77	26	4,860	40.93	0.84	25	273	5.18	1.90	8	1,082	10.27	0.95	23
Cattle	293	3.59	1.23	7	603	6.05	1.00	5	86	0.88	1.02	25	379	3.79	1.00	15
Other livestock	833	10.22	1.23	6	2,897	27.39	0.95	14	70	0.74	1.05	21	101	0.92	0.91	24
Dairy farms	53	0.65	1.23	4	174	1.63	0.94	16	235	2.40	1.02	24	9	0.09	0.99	18
Wool	1	0.02	1.28	2	66	0.64	0.98	8	0	0.00	3.30	1	119	1.21	1.02	11
Forestry	183	1.72	0.94	22	3,565	32.91	0.92	18	116	1.28	1.11	18	29	0.27	0.95	21
Fishing	427	4.14	0.97	21	3,040	25.02	0.82	27	128	1.31	1.03	23	19	0.14	0.72	30
Coal	1	0.01	1.22	8	2,995	23.31	0.78	29	10	0.10	1.04	22	56	1.15	2.05	1
Oil	14,263	142.72	1.00	19	8,800	83.25	0.95	13	78	1.50	1.91	7	0	0.00	0.71	31
Gas	1,478	19.62	1.33	1	5,693	62.50	1.10	2	0	0.00	2.21	6	0	0.00	1.03	9
Other Mnrls	156	0.92	0.59	29	4,786	31.13	0.65	31	19	0.14	0.77	29	481	5.52	1.15	5
Red meats	39	0.43	1.11	11	1,370	13.53	0.99	7	25	0.25	0.97	28	70	0.79	1.13	6
Other meats	48	0.36	0.76	27	2,654	25.67	0.97	9	10	0.23	2.34	3	145	1.47	1.01	12
Veg Oils	39	0.20	0.51	30	4,537	34.44	0.76	30	1	0.04	2.60	2	153	1.53	1.00	17
Dairy Prods	9	0.11	1.26	3	418	3.86	0.92	17	15	0.18	1.26	12	9	0.09	0.95	22
Proc Rice	20	0.06	0.28	31	6,239	59.33	0.95	11	27	0.35	1.32	11	37	0.37	1.00	16
Sugar manuf.	1	0.01	1.01	18	2,130	18.68	0.88	22	66	0.79	1.18	15	74	0.56	0.75	29
Other foods	328	2.63	0.80	25	10,711	87.31	0.82	28	118	1.40	1.18	16	819	7.91	0.97	19
Bev., Tobacco	156	1.10	0.71	28	5,734	48.21	0.84	26	269	2.03	0.76	30	1,009	9.62	0.95	20
TCF	825	8.23	1.00	20	21,481	185.99	0.87	23	55	1.25	2.28	5	770	8.38	1.09	7
Other Manuf	5,211	62.37	1.20	9	77,082	703.62	0.91	20	344	7.96	2.31	4	2,449	30.94	1.26	3
Utilities	2,359	27.38	1.16	10	25,025	413.36	1.65	1	1,039	6.72	0.65	31	1,133	19.04	1.68	2
Trade Transport	8,775	96.60	1.10	12	30,536	308.65	1.01	4	1,391	15.10	1.09	20	2,547	26.61	1.04	8
Services	10,271	107.23	1.04	15	51,188	509.31	0.99	6	1,628	17.77	1.09	19	4,004	40.11	1.00	14

Table 2. Output effects from 1% improvement in international and domestic transportation in Nigeria

	international transportation		domestic transportation	
	Output		Output	
	%	million \$	%	million \$
Paddy rice	-0.01	-0.03	0.00	0.01
Wheat	-0.07	-0.01	0.29	0.02
Other grains	0.00	-0.03	0.05	0.50
Fruits, vegetables	0.00	0.17	0.01	0.69
Oilseeds	-0.03	-0.04	-0.11	-0.16
Sugar cane	-0.05	0.00	0.13	0.01
Plant fibers	-0.11	-0.07	-0.10	-0.06
Other crops	-0.09	-0.18	-0.50	-1.00
Cattle	0.03	0.08	0.22	0.65
Other livestock	0.06	0.48	0.23	1.91
Dairy farms	-0.03	-0.02	0.26	0.14
Wool	-0.03	0.00	-0.62	-0.01
Forestry	0.14	0.26	0.07	0.12
Fishing	0.02	0.11	0.13	0.54
Coal	-0.10	0.00	0.37	0.00
Oil	-0.01	-1.23	0.01	2.04
Gas	0.09	1.26	-0.04	-0.57
Other Mnrls	-0.09	-0.13	0.22	0.34
Red meats	0.17	0.06	0.17	0.07
Other meats	-0.14	-0.07	0.07	0.03
Veg Oils	-0.31	-0.12	0.04	0.02
Dairy Prods	-0.30	-0.03	-0.02	0.00
Proc Rice	-0.49	-0.10	-0.13	-0.02
Sugar manuf.	-0.14	0.00	-0.10	0.00
Other foods	-0.02	-0.06	-0.01	-0.04
Bev., Tobacco	-0.03	-0.04	0.22	0.34
TCF	-0.14	-1.19	0.39	3.25
Other Manuf	-0.10	-5.07	0.37	19.26
Utilities	0.00	0.08	0.20	4.64
Trade Transport	0.01	1.23	-0.33	-29.12
Services	0.00	0.16	0.08	7.81

Table 3. Output and trade effects from trade liberalization in Nigeria

	Output		Exports		Imports	
	%	million \$	%	million \$	%	million \$
Paddy rice	-2.2	-7	25.5	1	163.2	0
Wheat	-17.0	-1	51.4	0	-0.7	-2
Other grains	-2.3	-21	6.0	0	9.3	0
Fruits, vegetables	-0.9	-47	10.1	1	139.2	22
Oilseeds	0.2	0	9.4	2	27.1	0
Sugar cane	-9.1	-1	19.2	0	-12.4	0
Plant fibers	-9.0	-6	18.9	6	-9.3	0
Other crops	5.8	12	6.2	12	-3.3	-1
Cattle	2.3	7	14.5	0	9.0	5
Other livestock	2.7	23	4.8	0	40.1	4
Dairy farms	-8.7	-5	36.6	0	-29.8	0
Wool	32.0	0	32.7	0	-22.1	0
Forestry	-0.7	-1	0.7	0	3.7	0
Fishing	-7.3	-31	5.3	0	-8.0	0
Coal	-14.3	0	0.0	0	0.0	0
Oil	1.3	192	2.8	370	-15.6	0
Gas	-1.4	-21	-3.9	-34	87.8	0
Other Mnrls	-1.8	-3	2.9	3	2.3	1
Red meats	3.9	1	141.0	0	-4.3	-1
Other meats	-59.4	-29	29.4	0	116.0	26
Veg Oils	-61.0	-24	41.0	0	54.1	20
Dairy Prods	-11.9	-1	32.8	0	2.1	4
Proc Rice	-66.0	-13	13.4	0	2.8	11
Sugar manuf.	-0.7	0	11.4	0	-0.9	0
Other foods	-6.9	-23	14.7	18	7.0	30
Bev., Tobacco	-26.1	-41	13.0	4	28.0	34
TCF	-34.3	-283	66.0	108	39.7	348
Other Manuf	-14.3	-744	51.9	155	15.0	1,271
Utilities	6.0	142	30.6	79	-6.9	-1
Trade Transport	3.7	327	11.9	45	-5.0	-64
Services	-0.5	-55	10.6	64	-3.6	-84

Figure 1. Welfare gains from 1% sector-specific Hicks-neutral technological progress, by sector

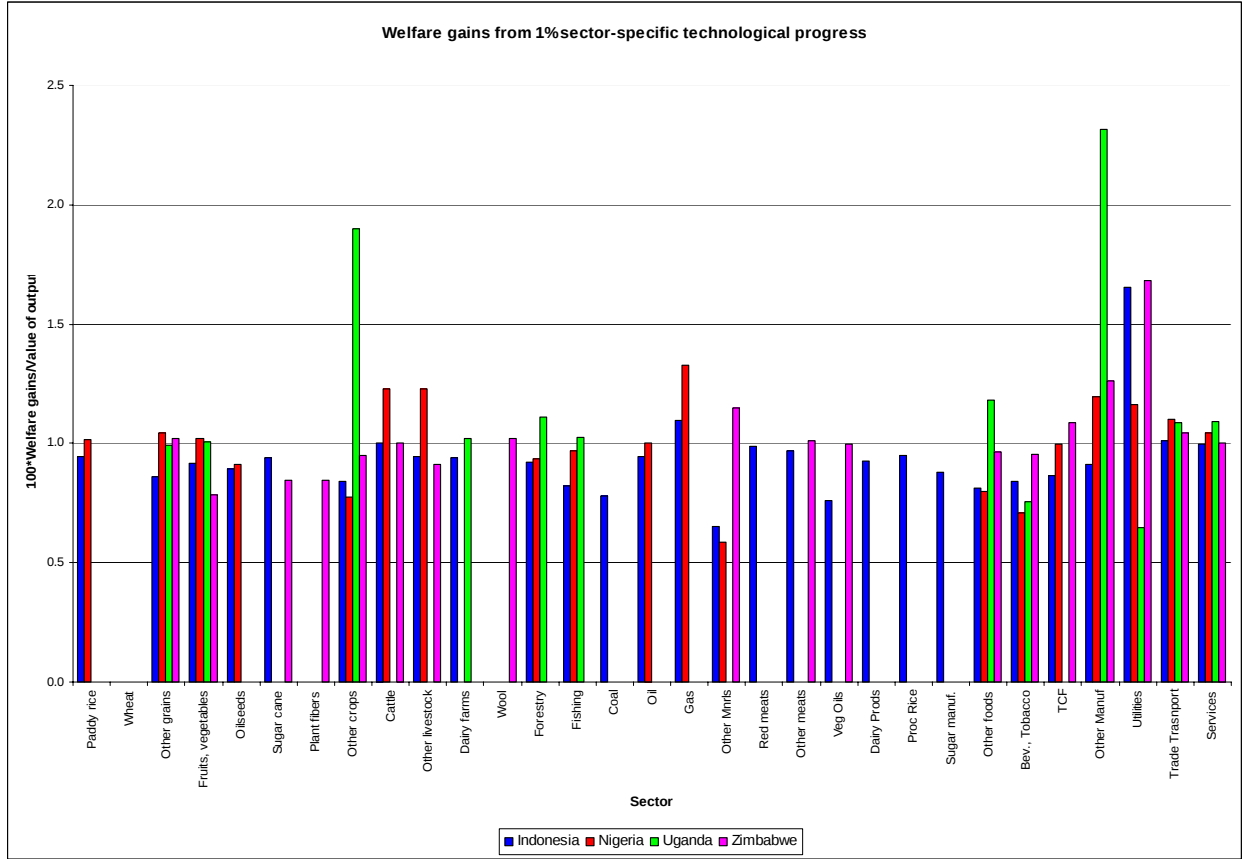


Figure 2. Welfare gains from 1% primary factor biased technological progress, in Nigeria, by sector

